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California is increasing its integration of municipal recycled water into its water supply portfolio. In some parts of the state, recycled water meets approximately 7 percent of water supply demands. Although the statewide total is an increase since the 2009 CWP Update, it is still far short of previously established goals. Municipal recycled water benefits the state and individual water users by reducing water conveyance needs, providing local water supplies, and being a drought-resistant resource. This resource management strategy (RMS) will discuss the current status of recycled water in California, what some of the challenges are to its increasing use, and the resources needed to continuing to increase municipal recycled water use.

Introduction to the 2013 Municipal Recycled Water RMS

The Municipal Recycled Water RMS addressees recycling of municipal treatment plant wastewater treated to a specified quality to enable it to be used again. Treated wastewater is usually primarily from domestic (household) sources, but it can include commercial, industrial, and institutional (CII) wastewater discharged to a sanitary sewer. Internal reuse of CII and agricultural water is also an important water issue, but is not discussed in this RMS because of the lack of available data. Within the Municipal Recycled Water RMS, the term "recycled water" refers to water that originates from a municipal treatment plant.

Changes from the 2009 Municipal Recycled Water RMS

The 2013 Municipal Recycled Water RMS is extensively changed from the 2009 version. There are new or revised policies (the 2009 Recycled Water Policy), proposed regulations (Draft Regulations for Groundwater Replenishment with Recycled Water), and a new statewide survey of recycled water users. In addition, there have been several reports prepared discussing recycled water applications, benefits, and challenges. Each of these will be discussed in the next section.

Affiliations with other Water Plan Update 2013 RMSs

Treating and delivering recycled water, as well as disposing of byproducts that may result from generating recycled water, involves issues that may also be discussed in other RMSs included in the Water Plan Update 2013. The key affiliations of other RMSs to recycled water, shown in Figure 11-1, include:

- **Chapter 2: Agricultural Water Use Efficiency**. Recycled water can be used to irrigate most crops.
- **Chapter 3: Urban Water Use Efficiency**. Recycled water can be used for landscape irrigation and commercial or industrial applications.
- **Chapter 5: Conveyance – Regional-Local**. Distribution of recycled water is planned and implemented on local and regional levels with local conveyance systems.
- **Chapter 14: Drinking Water Treatment and Distribution.** Future recycled water may be distributed via potable water distribution systems.

- **Chapter 16: Matching Water Quality to Use.** Recycled water could replace many instances where potable water is currently being used for non-potable applications.
- **Chapter 18: Salt and Salinity Management.** Recycled water production may result in brine generation. Use of recycled water may also have an overall impact to salinity of the underlying groundwater basin.
- **Chapter 19: Urban Runoff Management.** Stormwater can be used as a water supply mixing source for projects where recycled water is used for groundwater recharge.
- **Chapter 21: Economic Incentives**. Economic incentives are commonly used to initiate recycled water projects, enable infrastructure development, or support the use of lower quality water.
- **Chapter 22: Ecosystem Restoration.** Recycled water is often a water supply for ecosystem restoration projects.
- **Chapter 24: Land Use Planning and Management**. Use of recycled water can be constrained by availability of sites suitable for recycled water. Successful local planning can encourage locating potential recycled water users where it is available, as well as planning infrastructure needs to support future growth.
- **Chapter X: Outreach and Education.** Introduction of recycled water as a local water supply resource requires extensive public outreach and education regarding its uses, as well as addressing local water quality and health effect concerns.

PLACEHOLDER Figure 11-1 Municipal Recycled Water RMS Affiliations

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Definition of Municipal Recycled Water

The California Water Code (Wat. Code) provides the following definition for recycled water: "water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource" (Wat. Code § 13050(n)). "Recycled water" and "reclaimed water" have the same meaning and can be used interchangeably. The California Water Plan uses the term "recycled water". An illustration of the many paths that municipal recycled water can take for reuse is shown in Figure 11-2. The recycled water pathways shown in this figure do not indicate the level of recycled water treatment. Existing California law specifies required treatment levels for designated uses.

PLACEHOLDER Figure 11-2 Municipal Recycled Water Cycle

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

[This figure will be updated. Current figure is a mock-up]

Municipal water recycling is a strategy that increases the usefulness of water by reusing a portion of the existing waste stream that would be discharged to the environment, by redirecting the water to another local application. This action does not necessarily increase the amount of water in the water supply, but it enables conserving higher quality water for appropriate uses. Additionally, as a local water source, municipal recycled water can:

- Be an additional water source, possibly offsetting or delaying obtaining additional freshwater supplies
- Be a drought resistant water supply
- Provide an alternative for treatment and disposal of wastewater
- Reduce overall energy requirements, especially if it is replacing transferred water
- Reduce discharge of excess nutrients into surface waters
- Provide nutrients for crops or landscape plants
- Support environmental habitats, such as wetlands

Recycled water is integrated into California's water supply for potable or non-potable uses (Figure 11-3). Non-potable reuse includes any application not involving drinking water for human consumption, such as landscape or agricultural irrigation, commercial applications like car washes or dual-plumbed office buildings, or industrial process such as oil refineries or cooling towers. Potable reuse results in augmentation to drinking water supplies, and it can be either direct or indirect. Direct potable reuse is treated water conveyed directly from the wastewater treatment plant to the drinking water supply lines. Indirect potable reuse is treated water from the wastewater treatment plant discharged into recharge basins to infiltrate into groundwater aquifers or into surface water reservoirs used for drinking water supply.

PLACEHOLDER Figure 11-3 Potable and Non-Potable Municipal Recycled Water

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Water discharged from a wastewater facility may still be reused even if it is not a planned action, as shown in Figure 11-2. Typically, treated wastewater is discharged into rivers and streams as part of permitted disposal practices. Discharged water then comingles with the stream or river that may be a water source for downstream communities or agricultural users. When a downstream entity withdraws water from the stream, a portion of that water is treated wastewater from an upstream discharge that has comingled with the ambient stream flow. Estimates from California Water Plans prepared in the 1980's indicate that between 86 and 100 percent of wastewater discharged in Central Valley hydrologic basins is indirectly reused in this manner. Comingling of recycled water also occurs when it is used to recharge existing groundwater supplies (see Figure 11-2).

Treated wastewater can also be discharged to the ocean or other saline water bodies. This water usually is considered no longer practically available for reuse and is referred to as "irrecoverable water." The State recognizes recycling projects that capture municipal wastewater in coastal areas that would otherwise become irrecoverable water as "new water" supply. An estimated 0.9 million to 1.4 million acre-feet of "new water" could be realized by 2030 through recycling municipal wastewater that is discharged into the ocean or brackish bays (RWTF, 2003). Because discharges to the ocean or brackish water bodies support few, if any, downstream beneficial uses, such discharges are excellent sources of wastewater for future

recycling efforts (RWTF, 2003). These projects may also support energy-efficient water supply strategies because they more fully utilize the energy already expended to treat the water to disposal levels that would otherwise be discharged to irrecoverable sources.

An additional consequence of increasing direct municipal recycled water use is that the volume of water discharged into streams may be reduced, potentially adversely affecting downstream water rights or instream beneficial uses. Recognizing this, California Water Code requires that prior to making any change in the point of discharge, place of use, or purpose of use of treated wastewater, that change shall be reviewed by the State Water Resources Control Board (State Water Board) to ensure potential impacts to beneficial uses are considered before authorizing a change in the permitted discharge of municipal wastewater (Wat. Code §1211).

Recycled Water Use in California

Continued integration and expansion of recycled water into California's water supply options is necessary to meet future demands despite uncertain climactic conditions. Recognizing the importance of recycled water in meeting future water demands, language is included in State law: "It is hereby declared that the people of the state have a primary interest in the development of facilities to recycle water containing waste to supplement existing surface and underground water supplies and to assist in meeting the future water requirements of the state" (Wat. Code § 13510). The state strengthens its purpose by stating in the Water Code that under certain conditions the use of potable water for nonpotable purposes is a waste or unreasonable use of water if recycled water is available (Wat. Code § 13550 et seq.). This has been the basis for the past several decades in California for encouraging recycled water for non-potable uses, especially for industrial and irrigation applications.

Several important actions involving municipal recycled water have occurred since the 2009 California Water Plan Update. These include:

- Completion of the 2009 Municipal Wastewater Recycling Survey
- Adoption by the State Water Board of the Recycled Water Policy in 2009
- Release of revised Draft Regulations for the Use of Recycled Water for the Recharge of Groundwater (SB 918)

This section addresses past and current water recycling in the state, as well as each of the important actions involving municipal recycled water.

History of Recycled Water in California

Municipal recycled water has been used beneficially in California for over 100 years. In the earliest applications, farms located near urban areas in our drought-prone state used effluent from municipal wastewater treatment plants. By 1910, 35 sites were using municipal recycled water for agriculture purposes. From 1932 to 1978, the McQueen Treatment Plant, the first documented California treatment facility dedicated to treating recycled water (RMC Water and Environment 2009), supplied recycled water for irrigation in Golden Gate Park.

In 1952, 107 California communities were using municipal recycled water for agricultural and landscape irrigation. Following a national initiative to upgrade and improve the level of wastewater treatment in the 1970s, the uses of municipal recycled water applications began to diversify. Beneficial uses of California's recycled water now include landscape, agricultural, and golf course irrigation; commercial and industrial applications; environmental enhancement; groundwater recharge; and lake augmentation.

Current Recycled Water Use in California – the 2009 Survey

Statewide surveys conducted since 1970 quantified annual volumes of municipal recycled water use and have shown a steady increase in the amount and types of uses (Figure 11-4). These surveys accounted for only planned reuse with recycled water delivered directed to users or to groundwater recharge facilities. For the 2009 calendar year, the State Water Board and DWR conducted a survey of agencies involved with the treatment, conveyance, or beneficial reuse of domestic wastewater as recycled water. The survey results identified 669,000 acre-feet of treated municipal wastewater were beneficially reused in California in 2009, classified according to eleven beneficial uses. Beneficial uses in the 2001 and 2009 recycled water surveys are shown in Figure 11-5. Indirect potable reuse by adding recycled water to reservoir drinking water supplies and direct potable reuse do not currently occur in California.

PLACEHOLDER Figure 11-4 Municipal Recycled Water Use in California Since 1970

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

PLACEHOLDER Figure 11-5 Beneficial Uses of Municipal Recycled Water in 2001 and 2009

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Recycling of municipal wastewater occurs throughout California (Figure 11-6). Only seven of the state's 58 counties do not have identified recycling projects. In general, the highest countywide volumes of recycled water occur in parts of the state where local water resources are strained, population densities are high, or wastewater disposal is problematic (Figure 11-7).

PLACEHOLDER Figure 11-6 Municipal Recycled Water Use by County in 2009

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

PLACEHOLDER Figure 11-7 Regional Variations in Beneficial Uses of Municipal Recycled in 2009

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

The 2009 Survey identified 210 recycling systems, directly involving almost 300 agencies in some aspect of recycling municipal wastewater in the state. These projects range in size from less than 50 to more than 86,000 acre-feet in 2009, and involve many levels of complexity, from direct agricultural reuse to

multiple-levels of treatment and agency involvement. These projects are funded by local water suppliers, customers, and state or federal grants and loans obtained through individual or Integrated Regional Water Management (IRWM) funding applications.

Potential Recycling in 2020 and 2030

How much water will California be able to recycle in the future? Various future recycled water goals and mandates previously have been developed by state agencies (Table 11-1). The first goal of achieving 700,000 acre-feet by 2000 was not met, nor was the second of 1 million acre feet of water recycling by 2010, based on the 2009 survey and data included in the 2010 Urban Water Management Plans (UWMP).

PLACEHOLDER Table 11-1 Recycled Water Statewide Goals and Mandates

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Using the data from the 2009 Recycled Water Survey and the UWMP, DWR estimates that the 2020 and 2030 goals should be revised to ___, 000, and _____, 000 acre-feet [Numbers to be added after the review is complete – expected to be September or October]. No recommendations are made to modify the existing mandates. The revised 2020 and 2030 were developed using the 2009 recycled water survey data, the information submitted in the 2010 UWMPs, IRWM planning and implementation grants, Title XVI grants, and Clean Water State Revolving Funds (DWR, 2012 in preparation).

Collection of future actual recycled water use data in a manner consistent with approaches used in previous recycled water surveys will facilitate monitoring progress in meeting these identified recycled water goals and mandates. However, completing a voluntary recycled water use survey using the existing methodologies is a labor intensive effort. Initial discussions are underway to identify more efficient data collection approaches using mandatory, electronic reporting.

Recycled Water Use Policies, Regulations, Responsibilities and Funding

As the treatment level of municipal wastewater increases from primary, secondary, tertiary to advanced, the permitted uses of recycled water increase. State policies and regulations are in place to increase the use of recycled water in a manner that is protective of human and environmental health. State regulations mandate that producers and users of recycled water comply with treatment and use restrictions to protect public health and water quality.

In general, the levels of treatment for recycled water use are based on levels of human exposure and pathways of exposure leading to infection. The required levels of treatment are specified in Title 22 of the California Code of Regulations (Division 4, Chapter 3, §60301 et seq.). The Title 22 regulations also specify monitoring and reporting requirements and on-site use area requirements. For example, municipal wastewater that has completed tertiary treatment can be used to irrigate school yards, parks and residential landscape, and may be suitable for industrial applications or use in office and institutional buildings for toilet flushing. Wastewater that has been treated to secondary levels is generally suitable for uses that do not include contact with unprocessed food crops or people, such as agricultural irrigation of animal feed

crops. Aside from the need to protect human health, there are special water quality needs for uses in agriculture or industry to grow crops or manufacture products. Higher levels of treatment may be needed for some industrial applications. Some agencies are able to provide multiple levels of recycled water treatment for various customer uses.

Recycled Water Roles

The current framework for regulating municipal recycled water has been in place since the 1970s. As established in state law, primary authority for overseeing municipal recycled water is divided between the State Water Board, including the nine RWQCBs, and the California Department of Public Health (CDPH). A memorandum of agreement between the two agencies documents this arrangement and clarifies the roles of the agencies. The CDPH regulates public water systems and sets standards for wastewater reuse to protect public health by adopting water recycling criteria based on water source and quality and specifying sufficient treatment based on intended use and human exposure. The treatment objective is to remove pathogens and other constituents, making the water clean and safe for the intended uses. The State Water Board, through the RWQCBs, has the roles of permitting and providing ongoing oversight authority for water recycling projects. The permits incorporate applicable CDPH Title 22 requirements and specify approved uses of recycled water and performance standards.

Four other state agencies are directly involved with municipal recycled water issues in California and implement various sections of state law: DWR, California Public Utilities Commission (PUC), California Department of Housing and Community Development (HCD), and California Building Standards Commission (CBSC). Statutes governing municipal recycled water are currently contained within the Water, Health and Safety, Government, Public Resources, and Public Utilities codes, and regulations are in various subdivisions (titles) of the California Code of Regulations (CCR). State agency roles and responsibilities are summarized in Table 11-2.

PLACEHOLDER Table 11-2 State Agencies Recycled Water Roles and Responsibilities

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In addition to the statewide agencies, local city and county officials also have a regulatory role affecting municipal recycled water projects. In some cases, CDPH can delegate responsibilities to local officials if local municipal recycled water project sponsors agree with the delegation.

Recycled Water Use Statutes, Regulations, and Policies

Since the 1970s various statutes, regulations, and policies have been enacted and developed to address recycled water generation and use. Table 11-3 highlights some of them. Additionally, there are several new and pending regulations, which are discussed here.

PLACEHOLDER Table 11-3 Important Recycled Water Policies and Regulations

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Recycled Water Policy of 2009

The SWRCB in 2009 adopted a Recycled Water Policy to address issues of concern for permitting recycled water and protecting water quality, include salinity management, regulation of incidental runoff, and monitoring and regulation of constituents of emerging concern. The Policy calls for managing basins or subbasins through involvement and implementation salt and nutrient management plans and regulating incidental runoff through waste discharge requirements and best management practices. It also prioritizes approval of groundwater recharge projects utilizing municipal recycled water treated by reverse osmosis.

The Policy was modified in 2012 to incorporate input from a Chemicals of Emerging Concern (CEC) expert panel, as well as other public comments . . . . [This will need to be modified after the policy is released later this year]

Senate Bill 918

Senate Bill No. 918 was enacted in 2010 and focuses on the issues of indirect and direct potable reuse. It requires CDPH adoption of uniform water recycling criteria for indirect potable reuse for groundwater recharge in 2013 and surface water augmentation in 2016. It also requires CDPH by the end of 2016 to investigate and report to the legislature on the feasibility of developing uniform water recycling criteria for direct potable reuse. CDPH is required to convene an expert panel to advise CDPH on the development of criteria for surface water augmentation and the feasibility of direct potable reuse.

The CDPH published in November 2011 revised draft regulations to address groundwater replenishment using recycled water from a domestic source, for aquifers designated as a source of drinking water. The proposed regulations, if adopted with or without modification, would replace the existing 1978 regulations, which leave groundwater recharge criteria to case-by-case considerations by CDPH. The goal is to have the new regulations adopted by December 31, 2013, consistent with the statutory deadline established by Senate Bill 918.

The proposed groundwater recharge regulations seek to protect public health for projects utilizing indirect reuse of recycled water to replenish drinking water basins by establishing criteria that include, but are not limited to:

- source water control
- potential risks associated with pathogenic microorganisms, regulated contaminants, and unregulated contaminants
- effective natural barriers and multiple treatment barriers
- ongoing monitoring of recycled water and groundwater
- effective treatment processes
- time to identify and respond to failures
- review, reporting, and notification processes

Recycled Water Use Funding

Recycled water projects are funded directly by local water agencies and water users through rates, bonds, or rebates. Individual water users may also pay for projects that directly benefit them, such as an industry installing onsite or offsite infrastructure to receive recycled water or implanting process modification. Local agencies take the lead in indentifying, analyzing, and prioritizing the water resource projects in their jurisdictions to help achieve their identified goals. They then proceed with the best option to implement their identified projects. Once projects are constructed, revenue from the sale of recycled

water, potable water, and tax assessments are options for operation, maintenance, and debt service financing.

Other funding options include obtaining grants or loans from both state and federal sources, including:

- **Integrated Regional Water Management Grant Program (IRWMP)**, administered by DWR. The IRWM grant funding has enabled many communities in IRWM regions to implement water recycling projects. Water recycling is one of many resource management strategies that may be considered by IRWM regions in developing their water resource management portfolios.
- **Water Recycling Funding Program**, administered by the SWRCB. Provides low-interest loans and grants to local agencies. Water recycling is a key objective in the Strategic Plan Update (SWRCB, 2008), which identifies priorities and direction for the State Water Board and its nine Regional Water Boards.
- **Clean Water State Revolving Fund**, administered by the State Water Board. This program provides low-interest loans primarily for wastewater collection, treatment, and disposal, but it also funds recycling projects.
- **Title XVI,** administered by the US Bureau of Reclamation. Federal program that funds water reclamation and reuse projects.

With State budget constraints, it is likely that additional sources of funding will be limited in the future. This is a challenge, because implementation of recycled water projects often requires significant capital outlay, which many water suppliers are not able to fund without outside resources. However, given the importance of a reliable water supply to the state's economy, legislative support of providing additional funding for recycled water projects is a critical component of continued future recycled water development.

Potential Benefits of Water Recycling

Water recycling provides many benefits to local and statewide water supply reliability. Municipal recycled water increases local supplies, supports drought preparedness, mitigates climate change effects, provides environmental benefits, and can reduce energy consumption by lowering dependence on imported supplies.

Local Supply

Municipal recycled water has the advantage of being locally generated and re-used. The availability of additional local supplies can provide resource-limited communities with additional options for meeting water supply demands. Areas with constrained or declining groundwater supplies or heavy dependence on imported water may realize significant benefit from appropriate reuse of treated municipal wastewater. Recycled water may provide more cost-effective water self-sufficiency options than other resource development alternatives. It can also provide additional water resources to address increased demands from population growth.

Drought Preparedness

Establishing recycled water capacity supports managing water resources during drought cycles. Municipal recycled water as a water supply has less variability than traditional resources because domestic water disposal continues even during droughts. Wastewater production will decrease during a drought as households and commercial and industrial facilities conserve, but some wastewater generation will still occur.

Climate Change

Climate change is expected to increase atmospheric temperatures, resulting in a more variable precipitation regime and declining snowpack (DWR, 2008). Consequences of the warming climate are anticipated to increase water demand for urban, agricultural, and environmental uses, with a concurrent reduction in water supply availability and reliability.

Municipal recycled water will contribute to sustainability for urban water supplies facing changing climate conditions, particularly where local water supplies are limited. As a source of water for groundwater recharge, recycled water can support climate change planning. Groundwater basins and aquifers have the potential to store significant amount of water from a variety of sources, potentially including storm water and treated wastewater for later recovery. The use of recycled water to recharge groundwater basins addresses two fundamental challenges of climate change adaptation: 1) wastewater discharges represent a potential source of additional water that is currently underutilized or not utilized, and 2) groundwater recharge provides a practical storage solution. As stated earlier, CDPH has proposed draft regulations for the use of recycled water for groundwater recharge.

Energy Savings

Implementing municipal water recycling could reduce energy consumption, which may also support California's climate change mitigation efforts. Combustion of fossil fuels at power plants is a major source of greenhouse gas (GHG) emissions. The water sector uses a significant amount of the energy produced by those power plants, especially for the conveyance of water from its source to its use. Water recycling can provide a lower energy source of local water compared to importing water from other regions and desalination of ocean or brackish waters. Energy savings are greatest when recycled water is used in close proximity to wastewater treatment sources and additional treatment is not required beyond the treatment needed for wastewater disposal.

Recycled water used for most urban applications requires tertiary treatment, which requires a greater amount of energy and reduces the potential GHG savings. Energy savings realized by implementing a recycled water project depends on multiple factors, including the source of the water offset by the recycled water and the amount of increased treatment above disposal needed to reuse the water. Overall, it is assumed that implementing recycled water will provide energy use benefit by developing local resources versus conveyance energy demand.

Potential Costs of Recycled Water

Augmenting current statewide municipal recycled water funding, even in light of current statewide budget issues, is a long-term benefit because it develops local, reliable water supplies. The costs to implement recycled water projects vary based on the amount of water to be treated, treatment requirements, infrastructure needs, project planning, permitting, and financing. As a result, project costs can vary widely, as discussed further below.

Overall Costs

The Recycled Water Task Force (2003) estimated that between 2003 and 2030, an additional 1.4 million to 1.7 million acre-feet of additional wastewater could be recycled in California, based on how much wastewater was being discharged in the state. Of this, 0.9 million to 1.4 million acre-feet (62 to 82 percent) of the additional recycled water would be from discharges that would otherwise be lost to the ocean, saline bays, or brackish bodies of water (RWTF, 2003). The potential capital cost to implement that level of water recycling is estimated to be about $9 billion to $11 billion (in 2003 dollars, ibid.). Given the variability of local conditions and their effect on treatment and distribution costs, the estimated range of capital and operational costs of water recycling range from $300 to $1,300 per acre-foot of recycled water, but in some instances costs are above this range. The upper end of the current unit price for recycled water projects is confirmed by cost estimates recently prepared for two southern California projects, in San Diego and Oxnard. Per acre-foot costs for those projects are estimated to be between $1,191 and $1,900 (Fikes, 2012 and Wenner, 2012). These are urban projects and are reflective of higher-end projects, as well as the increasing costs of implementing recycled water projects. Therefore, for planning purposes, the State should consider that overall costs to reach the Recycled Water Task Force potential estimate will be at the higher end of the estimate, if not slightly higher.

To attempt to lessen rate payer impacts for these projects, increased focus on matching water use to water quality is an approach to implement more cost-effective projects. In a state where between 70 and 80 percent of developed water is used for agriculture, identifying projects that can convey secondary effluent to agricultural users and develop cooperative solutions could be a cost-effective water to meet water resource needs. Overall, the actual cost of recycled water projects will depend on the quality of the wastewater, the level of treatment required, the proximity of potential users to the sources of recycled water, and user costs associated with required upgrades or operational modifications. Uses that require higher water quality and/or have greater public health concerns will incur higher costs.

The cost to install new distribution systems is a major obstacle to the expansion of water recycling. Assessing costs of implementing recycled water programs should consider not only the cost of municipal infrastructure and its operation and maintenance, but also the cost to users – in particular larger industrial, agricultural, or commercial users that may require onsite modifications to maintain a separate system, including physical barriers for backflow prevention – or process modification to utilize a different water quality. In addition, a user may have additional operating costs for recycled water use as it integrates it into its water supplies.

Because recycled water is not classified as potable, regulatory constraints prohibit conveying recycled water and potable water in the same pipelines. Under current regulations, recycled water must be conveyed in a separate purple pipe distribution system that is labeled and readily distinguished from

potable water lines. The cost to install new purple pipe distribution mains from treatment plants to users can exceed the costs of obtaining alternate water sources or projects. As a consequence, extension of recycled water service to areas near treatment plants can be more cost-effective than extending infrastructure and service to more distant users. Distribution system cost can be an obstacle when evaluating the feasibility of supplying recycled water to large numbers of users or users more distant from urban wastewater treatment plants. Some water agencies have constructed satellite water recycling facilities to provide recycled water at locations near large concentrations of use.

How cost is a potential issue to increasing recycled water use in California is discussed further in the next section.

Individual User Costs

Additional costs that individual recycled water users may need to incur to receive recycled water include installing dual plumbing, modifying facility processes to use water of a different quality, and implementing cross-connection prevention. These can be significant cost components to potential recycled water customers using both potable and non-potable water.

Cross-connections, the accidental direct contact between potable and non-potable water systems, can contaminate potable water systems. Installation of air gaps, valves, or other controls are installed to prevent cross-connections because of pressure loss or other failures. Specific requirements vary by the water supplier or governmental agency. State regulations to protect public potable water systems from contamination by non-potable water are in Title 27 of the California Code of Regulations adopted by CDPH. The California Plumbing Code specifies protections to prevent potable water lines on the property of users from contamination.

The California Plumbing Code provisions governing dual plumbing in buildings were adopted in California in 2009. These codes established statewide standards to install both potable and recycled water plumbing systems in commercial, retail, and office buildings, theaters, auditoriums, condominiums, schools, hotels, apartments, barracks, dormitories, jails, prisons, reformatories, or other structures as determined by the CDPH. Some potential recycled water customers have faced challenges working with local inspectors to implement dual-plumbed systems, but these issues are expected to decrease as the systems become more common.

Major Issues Facing More Recycled Water Use

There are many issues to planning and implementing recycled water projects. However, based on the many successful projects in the states, these obstacles are not insurmountable. Focus on awareness of potential issues and sound planning practices to address or prevent negative impact are key components of successful project development.

Identifying and planning successful approaches to issues that could hinder implementation of increasing recycled water use both locally and statewide is critical for continued growth. The 2003 Recycled Water Task Force (RWTF) identified 26 recycled water “issues, constraints, and impediments” and provided recommendations to address them. More recently, three efforts conducted since the CWP 2009 Update

addressed issues, also referred to as barriers or challenges, facing increased municipal recycled water use. These efforts were:

- Metropolitan Water District (2010)
- Commercial, Industrial, and Institutional Task Force Report (DWR, 2012)
- National Research Council (2012)

Input from these documents supported development of the issue discussions included in this section. As part of future recycled water planning, a comprehensive review of the RWTF recommendations, in coordination with these more recently completed efforts, would provide guidance to DWR and the recycled water community on prioritizing future actions.

The issues addressed below are commonly confronted in planning and developing local and regional recycled water projects. Specific approaches to managing these issues specific to the proposed project should be addressed in project planning documents. DWR (and other state agencies directly involved with recycled water) will support these local efforts by preparing applicable statewide recycled water planning documents. This will include reviewing the National Academies recommendations (2012) and integrating those that are applicable to California.

Affordability

The affordability of recycled water has to be viewed from various perspectives, i.e., agencies implementing recycled water projects, users of recycled water, potable water suppliers whose revenue may be affected by recycled water use, and sewer and potable water ratepayers who may see their rates impacted by recycled water use. The component costs of these projects may constitute additional treatment above current wastewater treatment, disposal of treatment byproducts, storage and pump facilities, recycled water pipeline distribution systems, and on-site costs at user sites for specialized treatment of the recycled water, on-site plumbing, cross-connection control devices, and potential modification of commercial or industrial processes to accommodate recycled water. Who bears these costs depends on sources of revenue or financial assistance and how agencies agree to share costs based on the perceived beneficiaries.

The common reference point for water suppliers and users is what they currently pay for alternative water sources, such as potable water, or what agencies will have to pay in the future for new water supplies. Water suppliers in California are often dependent on other wholesale suppliers for their water supply. Prices for water often are set to recover costs from past projects and do not reflect the more expensive costs of new water supplies. Thus, prices are not a good benchmark for the true economic cost of new water supplies. New freshwater supplies are often developed at the regional or state level; whereas recycled water projects are often developed at the subregional or local level. It is difficult for any one water supplier or user to see the total water supply picture from the standpoint of costs.

Much of the water provided by federally funded projects is provided at discounted prices. Artificially low rates discourage adoption of water recycling and similar conservation programs. Consequently, there is growing recognition that pricing should more closely reflect the true costs to provide water and thus encourage more efficient use of existing water supplies. As identified in the National Academies' 2012 report on national water recycling, "Current reclaimed water rates do not typically return the full cost of treating and delivering reclaimed water to customers". Water pricing issues need to be considered early in the planning process for recycled water and thoroughly vetted with potential customers.

There can be benefits or costs that can be difficult to quantify and, even though real, are accrued indirectly such that they are not reflected in project costs. Recycled water has a benefit of reliability during droughts, but the monetary benefit accrues to the general economy and not to water suppliers. There may be a water quality benefit to reusing water instead of discharging treated wastewater into a river.

There are economic tools that can be used to provide a quantification of many indirect costs and benefits and a methodology, called an economic analysis, to compare recycled water and other water projects on an equal basis looking at total costs and benefits to society as a whole. When recycled water is found to be cost-effective compared to alternative water supplies using economic analysis, the challenge should then be to allocate costs according to beneficiaries and use financial incentives, such as regional rebates or state and federal loans and grants to encourage local water suppliers to build recycled water projects.

Interagency cooperation can be a way to allocate costs according to beneficiaries and achieve multiple objectives. Recycled water can improve regional water reliability and offset potable water that can be used in other areas. Regional water supplier partners can help local recycled water projects by contributing to construction and operation costs reflecting the regional benefits. Because of high initial infrastructure costs, many California communities are developing cooperative recycled water projects. These projects are developed and implemented locally to best serve the local needs. Projects have been developed where one community provides wastewater to another that then treats it to recycled water standards and distributes it. Another institutional arrangement is where a wastewater agency produces recycled water and a partnering water agency distributes it.

Advancements in water recycling treatment technology may bring down costs in the future, especially for indirect and, potentially, direct potable reuse, where high levels of treatment are often required. Another way of reducing costs is to incorporate purple recycled water pipelines in new developments at the same time as potable water lines are being installed. Long-range planning can anticipate where future recycled water users should be.

Nevertheless, dedicated recycled water distribution systems are costly. Adding recycled water to sources of drinking water, i.e., aquifers or surface reservoirs, eliminates the need for dual distribution systems. Introducing highly treated recycled water directly into potable water pipelines could also eliminate the need for separate recycled water lines. Groundwater recharge is widely practiced in California, but suitable aquifers are not available everywhere. Indirect potable reuse through augmenting surface drinking water reservoirs with recycled water and direct potable reuse are currently not allowed in California, but such practices would give communities more flexibility in how recycled water could be used at potentially lower cost than nonpotable reuse through separate recycled water pipelines. SB 918 established a schedule for CDPH to evaluate the surface water augmentation and adopt regulations and to evaluate direct potable reuse and report to the legislature.

The availability of local funding sources continues to challenge the implementation of new or expansion of existing projects. Where a recycled water project is found to be cost-effective from an evaluation of all costs and benefits from society's perspective, but more expensive than alternatives from a local perspective, there is a role for regional, state, and federal financial assistance to encourage the optimum water resource solution. The primary source of state funding has been the Water Recycling Funding Program administered by the State Water Board, providing low-interest loans and grants to local agencies. DWR administers the IRWM Grant Program. Water recycling is a resource management strategy that must be considered by an IRWM plan (IRWMP) and may be utilized as an active component of the plans to help the region meet water management goals and objectives. Water recycling projects identified in IRWMPs to be a key strategy may qualify for IRWM grant funding. The federal government, through the U.S. Bureau of Reclamation, has been a major contributor of grants and loans to recycling projects in California, primarily through the Title XVI program.

Water Quality

Water quality criteria for recycled water, established by CDPH, define water quality and treatment requirements to protect public health for most expected uses of recycled water. Under current regulations, water quality and monitoring requirements for recycled water projects are incorporated into the waste discharge or water reclamation permits issued by the Regional Water Boards to recycled water producers, distributors, and users.

Recycled water quality is to be protective of environmental and human health to support current uses and long-term sustainability. Recycled water quality issues include:

- Pathogen content (primarily bacteria and viruses)
- Salinity
- Nitrogen compounds
- Heavy metals
- Organic and inorganic substances (pharmaceuticals and personal care products, household chemicals and detergents, fertilizers, pesticides, fungicides, and hormones)

Research is ongoing regarding recycled water quality. Many organic compounds (generally referring to carbon-containing chemicals) are found in recycled water in very low concentrations and may be difficult to measure or identify. Many of these compounds have never been tested for effects on humans or the environment. Some that have been tested have evidence of potential harm but the evidence is insufficient to establish regulatory limits. These unregulated chemicals are often referred to as CECs.

The State Water Board's expert panel on CECs (State Water Board, 2010) provided recommendations, based on available information, for constituents to be included in required monitoring of various types of recycled water projects. These recommendations are being incorporated into the Recycled Water Policy. As additional information becomes available, future changes can be made to regulations and policies to protect the State's water resources while supporting implementation of new projects.

In addition to water quality being protective of human and environmental health, aligning water quality to end use is a key component of recycled water planning and implementation (see Chapter 16, Matching Water Quality to Use). Identifying the planned end uses and commercial/industrial application compatibilities are crucial recycled water considerations. In many cases, recycled water is integrated into existing processes. Most commercial and industrial applications are sensitive to water quality and recycled water typically has more minerals and organic content than many available alternative supplies. Subtle changes in water quality, such as increases or decreases of certain minerals or chemical species, can dramatically change the suitability of recycled water or the treatment requirements for use in an industrial process. Many water quality concerns associated with recycled water can be and are addressed with additional treatment by the water utility, on-site treatment, or other water management practices. These additional efforts have to be considered during recycled water planning, as well as financial impacts and responsibilities.

Public Acceptance

Public acceptance of recycled water projects is critical for their success. Water quality and cost factors are two issues often raised by the public. Integrating public input into the project planning phase has been a successful approach implemented by many agencies.

In general, there is public acceptance and support for most non-potable recycled water applications, such as agricultural and landscape irrigation, where there is a lower degree of direct human exposure. Public acceptance can be lower for projects with more direct links between recycled water and human consumption or contact. A factor that may raise some public concern is a perceived conflict between assurances that recycled water is safe and the necessity of regulations to protect the public from misuse. Outreach, education programs, and involvement during project planning can provide public reassurance that recycled water is adequately regulated to protect public health.

Environmental buffers – natural processes separating recycled water treatment from human end uses - are one component of public acceptance. For example, public concern about mixing recycled water with groundwater appears to be partly alleviated by the knowledge that infiltration, percolation, and underground residence time expose the water to natural cleansing processes. The actual benefit of environmental barriers versus engineered treatment with system controls has not been fully quantified. Additional research and planning may support how environmental buffers and engineered controls are perceived by the public and implemented in future projects.

Downstream User Impacts

Communities that discharge wastewater to rivers and streams contribute to the ambient water available for use by downstream users. The implementation of water recycling in upstream communities would reduce the volume of such discharges, potentially reducing the volume of ambient water available for

downstream reuse and/or fulfillment of environmental needs. In some circumstances, downstream users may have rights to the use of discharged wastewater, potentially preventing upstream communities from implementing recycling.

In the case of groundwater recharge with recycled water, the availability of groundwater downgradient may be increased, but there may be water quality impacts. Whether for storage or planned indirect use, the discharge of recycled water to wells, infiltration sites, or other locations underlain by permeable soil and geologic materials has the potential to introduce contaminants, including salts, into potable groundwater sources and aquifers. Modern microfiltration, reverse osmosis, and disinfection practices produce exceedingly high quality recycled water, but lingering concerns about pathogens, emerging contaminants, or other potentially unknown contaminants warrant continued research to advance the science and technology in this area. Presently, California does not approve direct potable reuse projects, that is, where recycled water is piped directly from a treatment plant into a drinking water supply.

Recommendations to Increase Recycled Water Use

1. The Recycled Water Task Force presented 26 recommendations to increase water recycling in its report, Water Recycling 2030: Recommendations of California's Recycled Water Task Force (DWR, 2003). Significant accomplishments have resulted from implementing the Task Forces' recommendations. With the 10-year anniversary of the completion of the Task Force's efforts, DWR intends to review the recommendations and prioritize progress that should occur to complete the Task Forces' mission.
2. State agencies including the State Water Board, Regional Water Boards, CDPH, DWR, and the CPUC should develop a uniform interpretation of State standards for inclusion in regulatory programs and IRWMPs, and clarify regulations pertaining to water recycling including permitting procedures, health regulations and the impact on water quality. It is important to recognize that uniformity in State standards does not mean uniformity in permit terms and conditions, however, as implementation should account for the variability in local conditions and local needs. Implementing this recommendation could also streamline existing recycled water regulations. Internal and cross-training of agency staff could be a key method of accomplishing this.
3. The National Academies (2012) completed a comprehensive review of how recycled water use can be expanded. There are numerous recommendations included in this report, as well as possible approaches to implementing them. In 2013, DWR will take the lead in working with the other California State agencies involved with recycled water to develop an approach to implementing these recommendations in California.
4. DWR will continue to identify opportunities to increase statewide planning, development, and implementation of recycled water. It is intended that this will be accomplished with comprehensive statewide planning documents and regional interactions over the next few years.
5. The State Legislature is urged to provide additional funding to be dedicated to planning and implementing recycled water projects in the state. Although some funds are available through IRWM grants and loans, the cost of implementing these projects can make them difficult to put forth in the existing grant processes, especially with so many water suppliers facing financial challenges. If California intends to reach its water recycling mandates and goals and support future water supply reliability to support economic growth, then additional funds dedicated to recycled water implementation will need to be provided.

6. To be able to monitor progress in meeting targets or achieving progress in beneficially using recycled water, there is a need for reliable and periodic data collection. Voluntary surveys have been the historic method of data collection. Mandating standardized data collection integrated with electronic reporting could facilitate the collection of data and the availability of the data for use. DWR, the State Water Board, and CDPH should work together to accomplish this objective.

Municipal Recycled Water in the Water Plan

[This is a new heading for Update 2013. If necessary, this section will discuss the ways the resource management strategy is treated in this chapter, in the regional reports and in the sustainability indicators. If the three mentions are not consistent, the reason for the conflict will be discussed (i.e., the regional reports are emphasizing a different aspect of the strategy). If the three mentions are consistent with each other (or if the strategy is not discussed in the rest of Update 2013), there is no need for this section to appear.]

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Additional References

Personal Communications

Table 11-1 Recycled Water Statewide[a] Goals and Mandates

Target Type [b]	Target Volume (thousands acre-feet)					Notes	Source
	2000	2010	2015	2020	2030		
Potential		1,030			2,050	Midrange of projected potential use increases above 2002 levels.	2003 Recycled Water Task Force Report
Goal	700	1,000					Water Recycling Act of 1991
Goal			1,250				SWRCB Strategic Plan Update: 2008-2012
Goal				1,525	2,525	1 million acre-feet above 2002 [c] for 2020 and 2 million acre-feet above 2002 for 2030.	SWRCB 2009 Recycled Water Policy.
Goal				TBD	TBD	Based on UWMP and 2009 Recycled Water Survey data	DWR 2012
Mandate				869	1,169	200,000 acre-feet above 2009 for 2020 and an additional 300,000 acre for 2030	SWRCB 2009 Recycled Water Policy.

[a] The actual 2009 statewide volume of beneficially reused municipal recycled water was 669,000 acre-feet.

[b] Potentials, mandates, and goals are objectives cited by identified sources. They are developed using various approaches. Mandates are stronger objectives, but in this case do not carry a defined penalty for non-attainment.

[c] The Recycled Water Policy indicates that 2020 and 2030 goals are determined relative to the 2002 recycled water levels. The 2001 and 2002 numbers are considered the same because they were based on the same data.

Table 11-2 Regulatory Agency Roles and Responsibilities for the Regulation and Use of Municipal Recycled Water

Agency	Role	Responsibility	California CCR
Department of Public Health	Protects public health	• Adopts uniform recycled water criteria for non-potable and potable recycled water projects1 • Provides recommendations for recycled water project permits • Reviews and makes recommendations on sites proposed for recycled water use • Oversees cross-connection prevention2 • Oversees protection of drinking water sources • Regulates public drinking water systems	Titles 17 and 22
State Water Resources Control Board	Protects Water quality and water rights	• Establishes general policies governing recycled water project permitting • Oversees RWQCBs • Provides financial assistance to local agencies for recycled water projects • Allocates surface water rights	Title 23
Regional Water Quality Control Boards (nine)	Protects water quality	• Issues and enforces permits for recycled water projects, incorporating Title 22 requirements and CDPH recommendations • Protects surface and ground water quality from recycled water impacts	Title 23
Department of Water Resources	Manages statewide water supply	• Evaluates use of and plans for potential future recycled water uses through the preparation of the California Water Plan • Provides financial assistance to local agencies for recycled water projects • Adopts standards for recycled water indoor plumbing	Title 24 (California Plumbing Code, Chapter 16A, Part II)
Public Utilities Commission	Oversees rates and revenues of investor-owned utilities	• Approves rates and terms of service for the use of recycled water by investor-owned utilities	Title 20
Department of Housing and Community Development	Oversees building standards for dwellings, including institutions and temporary lodgings	• Adopts standards for graywater systems in residential structures • Adopts standards for nonpotable water systems within buildings over which it has jurisdiction	Title 24 (California Plumbing Code, Chapter 16A, Part I; Chapter 6)
California Building Standards Commission	Oversees adoption of standards for buildings	• Will adopt standards for graywater systems in nonresidential structures in 2011 cycle of California Building Standards Code • Oversees the adoption of California Plumbing Code, including provisions added by other state agencies	Title 24 (California Building Standards)
Local Building Officials	Oversees building design, including plumbing	• Enforces building standards, including California Plumbing Code	Title 24
County environmental health departments	Protects drinking water systems	• Enforces cross-connection control • Reviews and makes recommendations on proposed recycled water use sites	Titles 17 and 22

As of November 2011, CDPH has adopted regulations in Title 22 for non-potable use of recycled water, but not for potable reuse projects. SB 918 requires CDPH to adopt uniform water recycling criteria for indirect potable reuse projects involving groundwater recharge and surface water augmentation.

May delegate some responsibilities for review of new sites and cross-connection control to the local County Health Departments with the permission of the local recycled water provider

Table 11-3 Important Recycled Water Policies and Regulations

Year	Action	Organization	Summary
1984	Water Quality Order 84-7	State Water Board	Pursuant to California Water Code, Section 13142.5(e), in cases where discharges of wastewater to the ocean are proposed in "water-short" areas, the report of waste discharge should include an explanation as to why the effluent is not being recycled for further beneficial use
2001	AB 331, Recycled Water Task Force	California Assembly	Established a 40-member Recycled Water Task Force (Task Force) to evaluate the current framework of State and local rules, regulations, ordinances, and permits to identify the opportunities for and obstacles or disincentives to increasing the safe use of recycled water. The Task Force was composed of 40 people representing federal, State, local government, public health professionals, private sector entities, environmental organizations, University of California, internationally recognized researchers, and public interest groups. The Task Force was a cooperative effort of DWR, the State Water Board, and DHS (now CDPH).
2003	Recycled Water Task Force	Department of Water Resources	Presented its findings and recommendations in a final report titled *Water Recycling 2030, Recommendations of California's Recycled Water Task Force*. The Task Force estimated the future potential and costs of water recycling and made a wide variety of findings, many of which are reflected in this chapter. The Task Force issued 26 recommendations to increase water recycling. The recommendations are broad, and are not limited to legislative actions or statutory changes and as of this update are still worthy recommendations in need of being fully implemented. Work has been accomplished on a few (most) of the recommendations.
2003	AB 344, Water Softeners	California Assembly	Authorized local agencies to adopt regulations governing water softeners or conditioning appliances that discharge salt into the community sewer system. The Water Softening and Conditioning Appliances bill specifically authorizes local agencies, by ordinance, to limit the availability or use, or prohibit the installation, of water softening or conditioning appliances that discharge to the community sewer system.
2004	Incidental Runoff Memorandum	State Water Board	Reviewed the legal requirements of federal and State statutes and regulations that relate to the regulation of incidental runoff and to determine the available regulatory and enforcement options, conducted legal analysis, and conducted stakeholder meeting to arrive at the decisions in the memorandum.
2006	Uniform Analytical Method for Economic Framework	State Water Board	Partially funded research project to develop an Uniform Analytical Method for Economic Analysis framework for evaluating the benefits and costs of water reuse by the WateReuse Foundation (August 2006). The State Water Board has convened an Economic Analysis Task Force with participation from state, federal and university members in fall 2008.
2007	AB 1481, Landscape Irrigation	California Assembly	Required the Regional Water Boards to prescribe general waste discharge requirements (General Permit) for landscape irrigation that uses recycled water for which the CDPH has established uniform statewide recycling criteria. The State Water Board adopted this General Permit for Landscape Irrigation of Municipal Recycled Water which further supports the use of recycled water in California while protecting the water quality
2009	Recycled Water Policy	State Water Board	For implementing state statutes, regulations, and policies for recycled water projects to establish more uniform interpretation (SWRCB, 2009a, 2009b). This policy aims to increase the use of recycled water from municipal wastewater sources (as defined in Wat. Code § 13050(n)), in a manner that implements state and federal water quality laws.

Year	Action	Organization	Summary
???	Climate Action Team	California Environmental Protection Agency	Created to formulate measures to mitigate the effects of climate change. Water recycling can contribute to the reduction of GHG emissions by replacing energy intensive imported water with local recycled water. To that end, the CAT formulated a water recycling measure to require the development and implementation of wastewater recycling plans. The Water Recycling CAT measure is identified in the AB32 Climate Change Scoping Plan prepared by the California Air Resources Board (CARB).
2009	Uniform Plumbing Code	Department of Water Resources	Addressed plumbing within buildings with both potable and recycled water systems, and is in the process of adopting a California version that will be enforceable in the state effective in 2010. This section of the plumbing code will provide guidance throughout the state to safely plumb buildings for indoor use of recycled water for toilet and urinal flushing.
2009	Recycled Water Symbol Code Change	Department of Housing and Community Development	Adopted a recycled water symbol code change to remove the requirement for the skull and crossbones symbol in sections 601.2.2 and 601.2.3 of the California Plumbing Code. Now the symbol is a picture of a glass containing liquid encircled with a line slashed through, indicating the liquid should not be ingested.

Figure11-1 Municipal Recycled Water RMS Affiliations

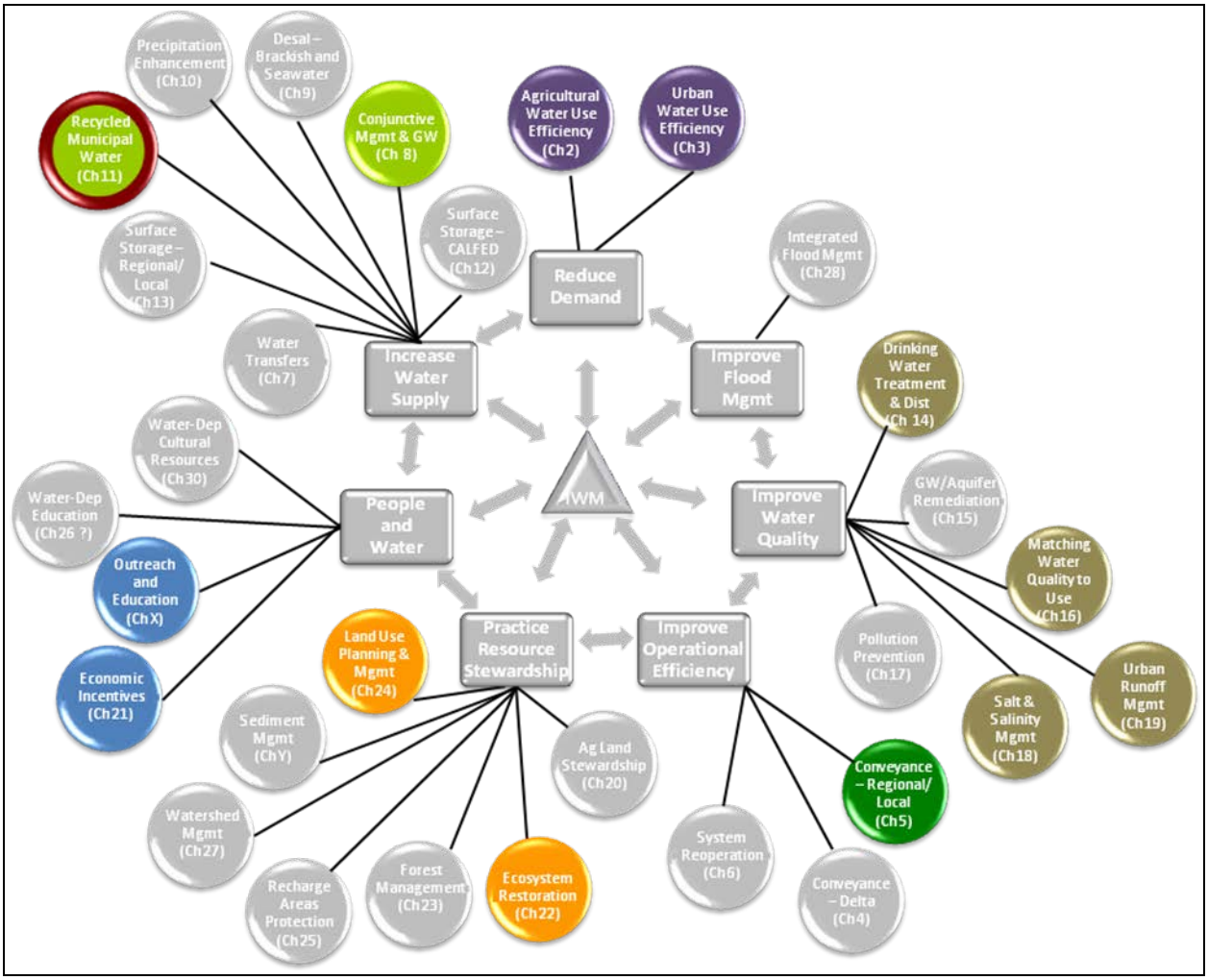

Figure 11-2 Generalized Recycled Water Use Cycle

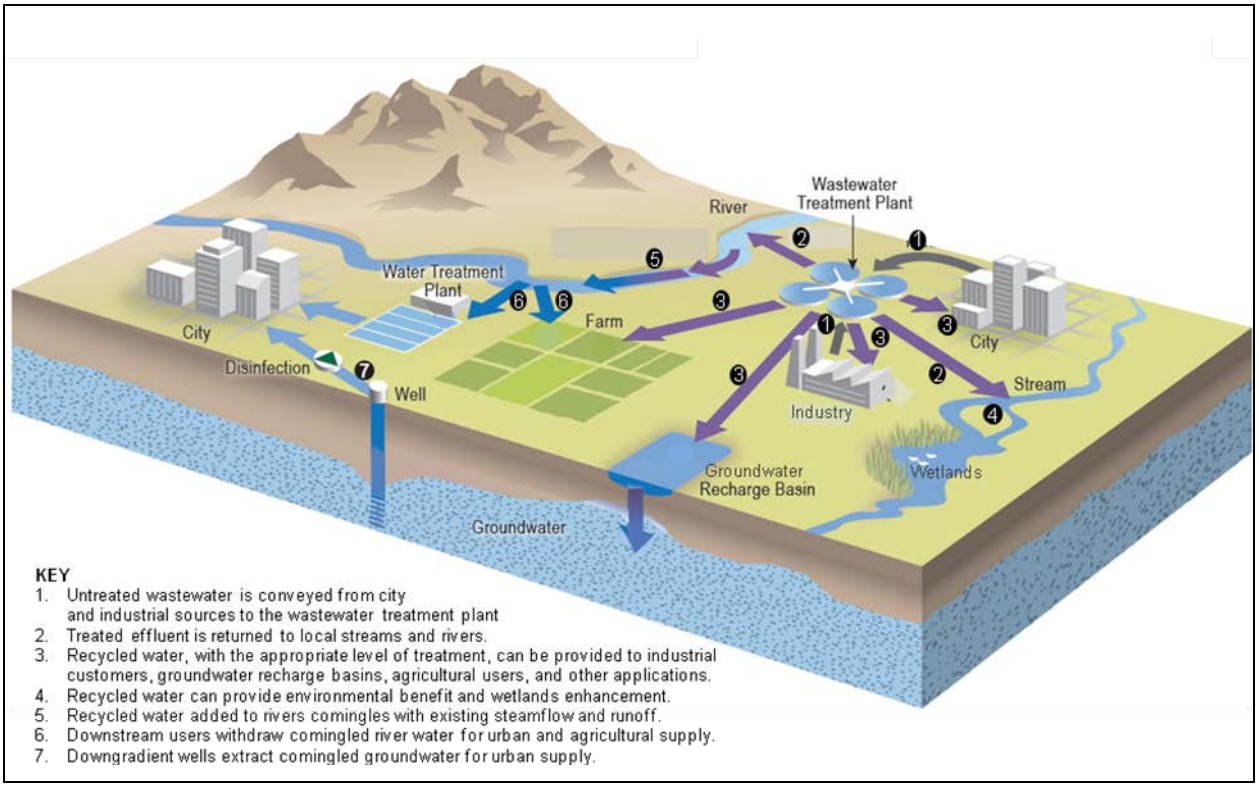

Figure 11-3 Potable and Non-Potable Municipal Recycled Water

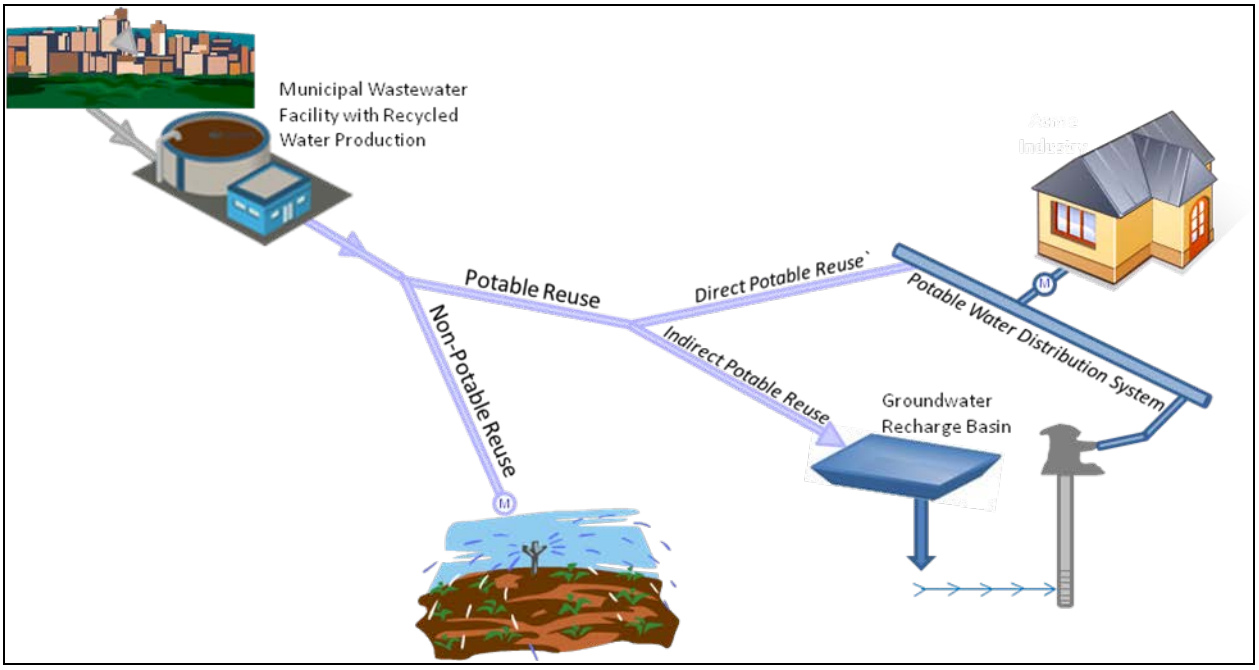

Figure 11-4 Municipal Recycled Water Use in California Since 1970

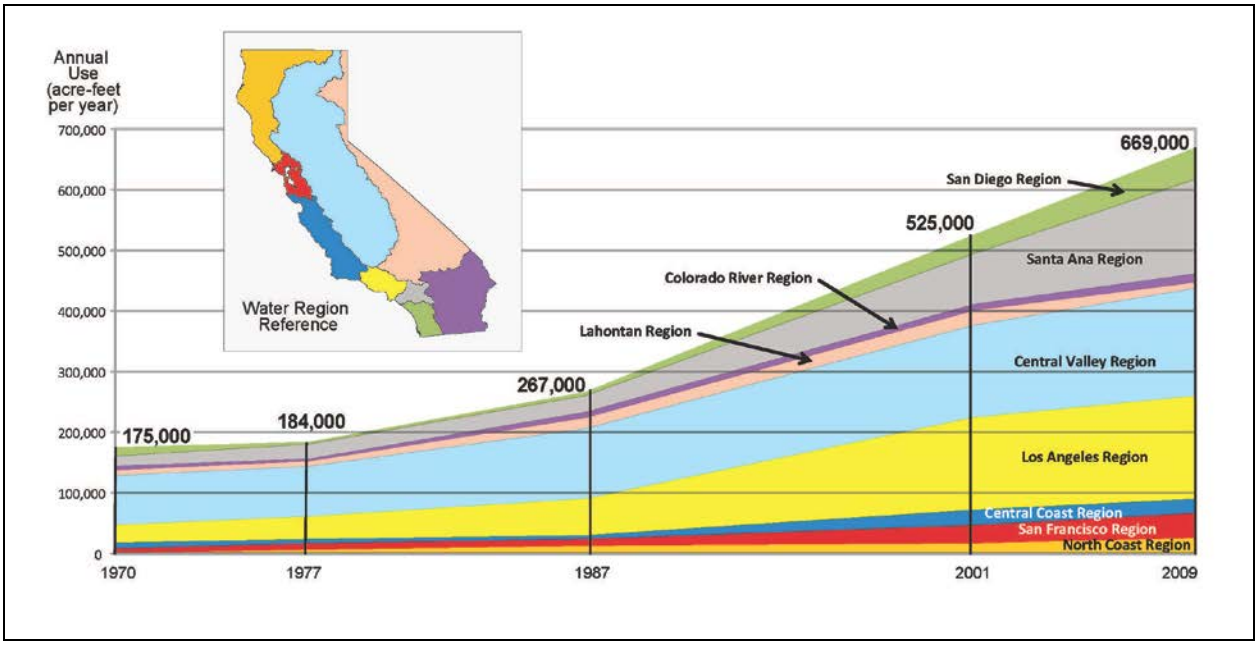

Figure 11-5 Beneficial Uses of Municipal Recycled Water in 2001 and 2009

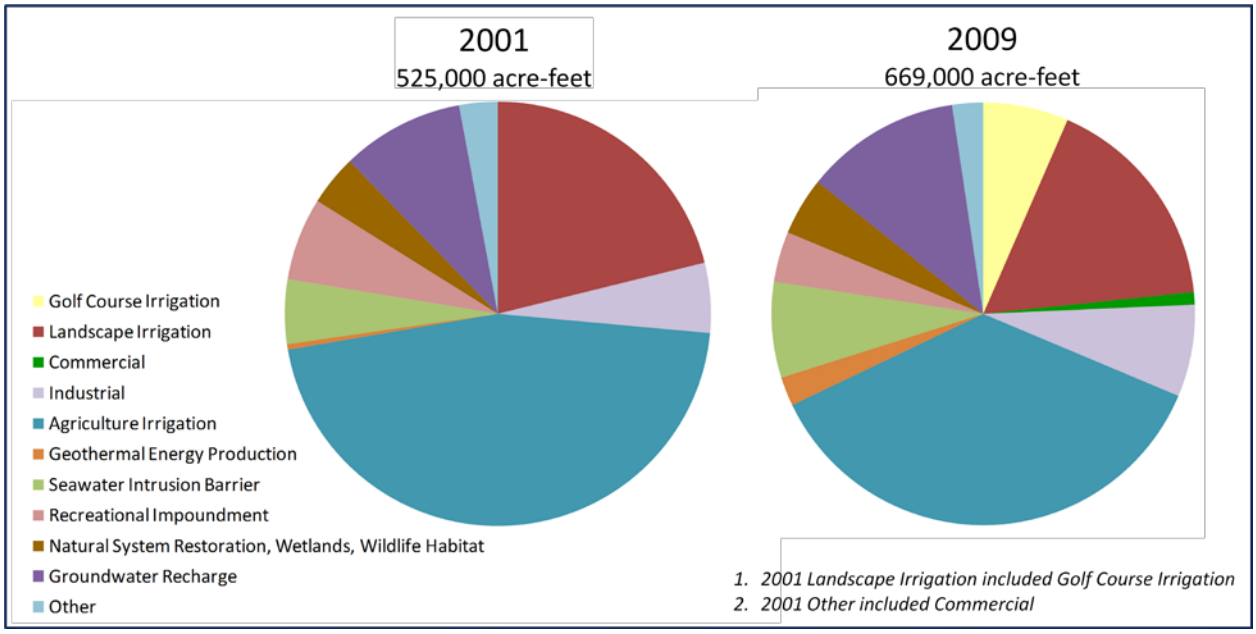

Figure 11-6 Municipal Recycled Water Use by County in 2009

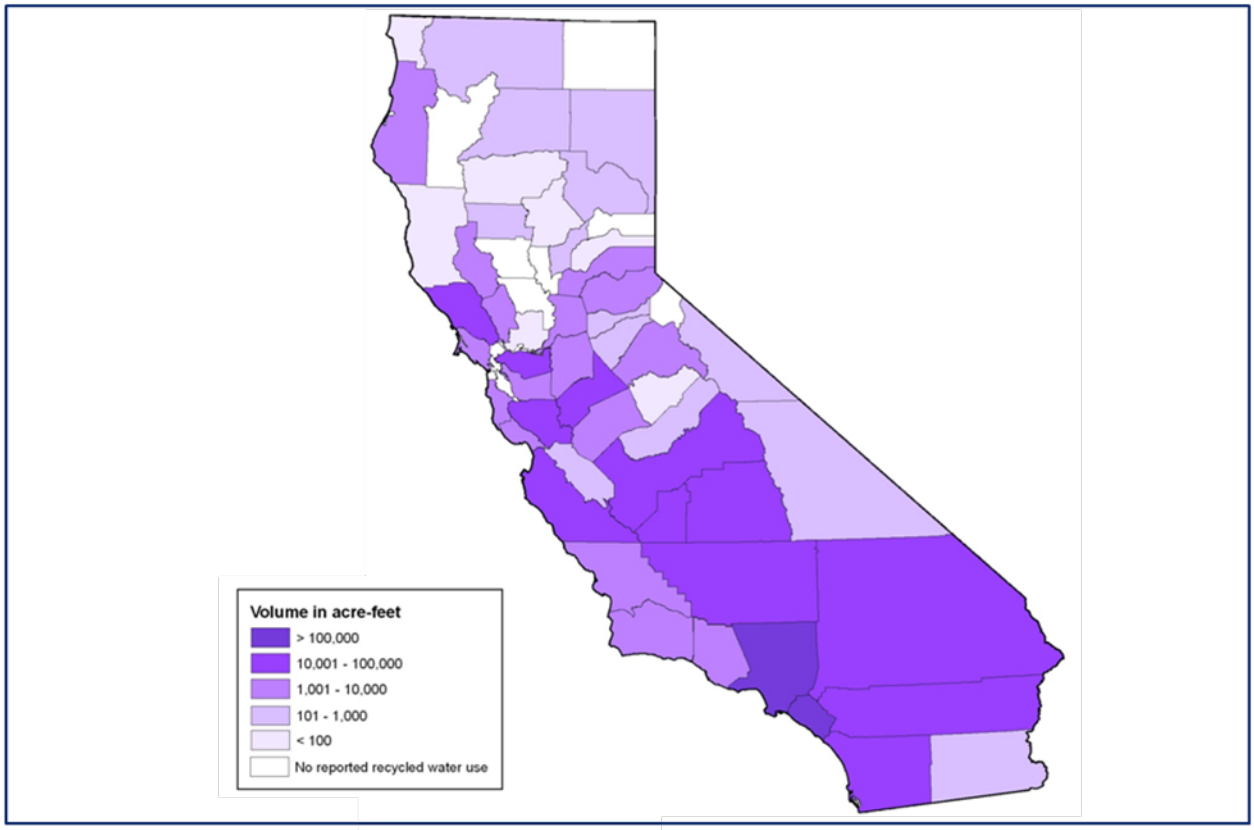

Figure 11-7 Regional Variations in Beneficial Uses of Municipal Recycled in 2009